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Major Weed Hosts of Nematodes in Crop Production

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MAJOR WEED HOSTS of NEMATODES in CROP PRODUCTION

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The role of weeds as hosts of other pests affecting crops is an indirect effect of weeds on crop production. Consequently, weed hosts have an economic impact on crop production. Weeds serve as hosts of many, if not all insects, nematodes, and pathogens affecting crops. In effect, weeds serving as pest hosts in the absence of crop hosts are reservoirs for those pests, maintaining pest populations which are available to attack crops when planted.

Some of the major commercial food and fiber crops of the world, major weeds associated with culture of those crops, and genera of plant parasitic nematodes hosted by those crops and their associated weeds will be considered herein. Various lists have been made of crops that "feed the world." A group of 15 species might serve as an example. This group includes the cereal crops rice, wheat, maize, sorghum, and barley; the legume crops soybean, peanut, and bean; the so-called root crops potato, sweet potato, and cassava; the so-called tree crops coconut and banana; and the sugar crops cane and beet. For discussion purposes, eight crops have been selected. They are rice, wheat, maize, potato, cassava, soybean, peanut, and sugarcane, plus the fiber crop cotton.

NEMATODES HOSTED BY CROPS

The genera of nematodes hosted by these nine crop species vary (Table 1). The number of these crops which host any given genus of nematode also varies. All of these crops host species of the root-knot nematodes, Meloidogyne, and the root-lesion nematodes, Pratylenchus. All except cassava host species of Helicotylenchus and Tylenchorhynchus. Although Meloidogyne, Heterodera, and Pratylenchus, in that order, are considered to be the three most serious genera of nematodes in crop production on a worldwide basis, only five of these nine crops host the cyst nematodes, Heterodera. The work by Goodey, et al. (5), was a major reference on plant hosts of nematodes. This reference was supplemented by information from annotated bibliographies (3, 4, 8, 9, 10) and from Holm, et al. (7). The work of Holm, et al. (7) was the chief reference on the major weeds associated with culture of the crops under consideration. The definitions of weeds in that work as being "serious," "principal," and "common" was used herein also and is discussed further under the heading "World's Worst Weeds?" on page 4.

NEMATODES HOSTED BY WEEDS

The weeds included in the following tables were reported as serious, principal, or common weeds in culture of the respective crops and were hosts of the nematodes hosted by that respective crop.

Rice. Eight plant species are major weeds of rice culture, four of which are listed

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among the "world's worst weeds." These eight major weed species host species in each of the 10 genera of nematodes hosted by rice (Table 2). Cyperus rotundus hosts species in nine of these 10 genera of nematodes. All eight weed species host Hirschmanniella. This information includes both paddy and upland rice culture.

Wheat. Three of the 11 major weed species of wheat culture are listed among the world's worst weeds. Species in each of the six genera of nematodes hosted by wheat are hosted by these 11 major weed species (Table 3). All 11 weed species host Meloidogyne and Ditylenchus. Chenopodium album hosts species in all six nematode genera.

Maize. Twenty plant species are major weeds of maize culture. Fourteen of them are listed among the world's worst weeds. These 20 major weeds host species in each of the 13 genera of nematodes hosted by maize (Table 4). Cynodon dactylon and Digitaria sanguinalis each host species in 11 of the 13 nematode genera hosted by maize, and Cyperus rotundus hosts nine genera. All 20 weed species host Meloidogyne and 17 host Pratylenchus.

Potato. Five of the 12 major weeds of potato culture are listed among the world's worst weeds. Species in each of the 11 genera of nematodes hosted by potato are hosted also by these major weeds associated with potato culture (Table 5). Digitaria sanguinalis hosts species in 10 of the 11 nematode genera hosted by potato. All 12 weed species host Meloidogyne.

Cassava. Six plant species are major weeds of cassava culture. Three of them are listed among the world's worst weeds. These six major weeds host species in each of the four genera of nematodes hosted by cassava (Table 6). All six weed species host Meloidogyne and five host Pratylenchus.

Soybean. Twelve of the 20 major weeds of soybean culture are listed among the world's worst weeds. Species in each of the 11 genera of nematodes hosted by soybean are hosted also by the major weeds associated with soybean culture (Table 7). Cyperus rotundus and Digitaria sanguinalis each host species in 10 of the 11 nematode genera. All 20 weed species host Meloidogyne, 14 host Pratylenchus, and 10 host Heterodera.

Peanut. Thirteen plant species are major weeds of peanut culture. Eight of them are listed among the world's worst weeds. The major weeds of peanut culture host species in each of the 11 genera of nematodes hosted by peanut (Table 8). Cyperus rotundus and Cynodon dactylon each host species in 10 of the 11 nematode genera, and Digitaria sanguinalis hosts nine genera. All 13 weed species host Meloidogyne and 11 host Pratylenchus.

Sugarcane. Ten of the 13 major weeds of sugarcane culture are listed among the world's worst weeds. Species in each of the 11 genera of nematodes hosted by sugarcane are hosted by the major weeds associated with sugarcane culture (Table 9). Digitaria sanguinalis hosts species in all 11 nematode genera. Cyperus rotundus hosts 10 and Cynodon dactylon hosts nine genera. All 13 weed species host Meloidogyne and 12 host Pratylenchus.

Cotton. Seventeen plant species are major weeds of cotton culture. Eleven of them are listed among the world's worst weeds. The 17 major weeds host species in each

of the nine genera of nematodes hosted by cotton (Table 10). Cynodon dactylon hosts species in all nine nematode genera. Cyperus rotundus and Digitaria sanguinalis each host eight genera. All 17 weed species host Meloidogyne and 14 host Pratylenchus.

WEED HOST SUMMARY

A tabulation of the weeds included above shows that Cyperus rotundus and Eleusine indica are major weeds in seven of the nine crops discussed (Table 11). Digitaria sanguinalis is a major weed in six of the nine crops. Echinochloa crus-galli, Echinochloa colonum, Sorghum halepense, Amaranthus spinosus, Ageratum conyzoides, Cyperus esculentus, Portulaca oleracea, and Rottboellia exaltata are major weeds in five of the nine crops. Ten of these 11 weed species are listed among the world's worst weeds. All of them host Meloidogyne and all but Echinochloa colonum host Pratylenchus.

Thirteen of the 46 weed species included in Table 11 are annual monocotyledonous plants, six of which are listed among the world's worst weeds. Nine are perennial monocotyledonous plants, four are listed among the world's worst weeds. Nineteen are annual dicotyledonous plants, four are among the world's worst weeds. Five are perennial dicotyledonous plants, one of which is listed among the world's worst weeds.

WEED HOST DISTRIBUTION

Consideration has been given to this point to the major weeds associated with culture of nine of the chief commercial food and fiber crops of the world and also to the nematodes hosted by those crops and their associated weeds. Consider now, the worldwide significance or distribution of those weeds, plus some additional ones, and the nematodes hosted by them. These selected weeds are classified as monocotyledonous annual, monocotyledonous perennial, dicotyledonous annual, and dicotyledonous perennial plants in Table 12. Their worldwide importance as weeds follows the classification system and survey of Holm, et al. (6) which lists the number of countries reporting given plants as either serious, principal, or common weeds. The weeds of each botanical classification are ranked according to the number of genera of nematodes hosted.

Annual monocots. For emphasis, attention is drawn to a few of those weed species. Among the monocotyledonous annual plants, Digitaria sanguinalis is an important weed in 39 countries and hosts species in 13 genera of nematodes (Table 12). Eleusine indica and Avena fatua are major weeds in 45 and 31 countries, respectively, and each hosts species in seven genera of nematodes. Echinochloa crus-galli and E. colonum are important weeds in 46 and 40 countries, respectively, and host species in four and five genera of nematodes, respectively.

Perennial monocots. Among the monocotyledonous perennial plants, Cyperus rotundus is a major weed in 74 countries and hosts species in 19 genera of nematodes (Table 12). Cynodon dactylon is an important weed in 63 countries and hosts species in 15 genera of nematodes. Sorghum halepense is a major weed in 37 countries and hosts species in 10 genera of nematodes.

Annual dicots. Among the dicotyledonous annual plants, Chenopodium album is an important weed in 49 countries and host species in 15 genera of nematodes (Table 12). Amaranthus spinosus and Solanum nigrum are major weeds in 41 and 36 countries, respectively, and each hosts species in eight genera of nematodes. Portulaca oleracea is an important weed in 53 countries and hosts species in six genera of nematodes.

Perennial dicots. Each of four dicotyledonous perennial weeds hosts species in five genera of nematodes (Table 12). Convolvulus arvensis is a major weed in 39 countries, Taraxacum officinale and Rumex acetosella are important weeds in 33 and 32 countries, respectively, and Plantago major is an important weed in 22 countries.

Although a plant may not have been identified as a major or important weed associated with a specific crop, it may be a significant host of nematodes affecting that crop. This may result from its presence at low, yet sufficient population levels to maintain significant populations of nematodes or may result from its presence prior to land preparation, having hosted a significant population of nematodes up to that time.

OTHER WEED HOSTS

Twenty important weeds of the world, which were not reported to be major weeds associated with culture of the crops discussed, were included in an expanded tabulation of important weed hosts of nematodes (Table 12). Ten of them each host species in four or more genera of nematodes. Twelve of them are important weeds in 20 or more countries. Among these 12 weeds, the annual dicotyledonous species Capsella bursa-pastoris and Sonchus oleracea are major weeds in 36 and 30 countries, respectively, and each hosts species in six genera of nematodes. Polygonum aviculare is also an important annual dicotyledonous weed in 36 countries and hosts species in four genera of nematodes. The significance of the perennial dicotyledonous weeds Taraxacum officinale, Rumex acetosella, and Plantago major was discussed above. Rumex crispus and Plantago lanceolata, also perennial dicotyledonous species, are major weeds in 24 and 29 countries, respectively, and host species in four and three genera of nematodes, respectively. Euphorbia hirta is an important annual dicotyledonous weed in 26 countries and hosts species in two genera of nematodes. Paspalum dilatatum is a major perennial monocotyledonous weed in nine countries and hosts species in five genera of nematodes.

WORLD'S WORST WEEDS?

It may be appropriate to raise the question as to which are the world's worst weeds. Holm, et al. (6), used five categories in rating plant weediness. The plant was: 1) a serious weed, 2) a principal weed, 3) a common weed, 4) present as a weed, and 5) present in the flora. These terms were not defined precisely, but the logical argument was presented that weed researchers and farmers understood from experience and could distinguish whether a plant was a serious, principal, or common weed. Among the factors implicit in these decisions was the level of competition of the weed in cultivated fields and grasslands, which affects productivity and yield. Another aspect was the effect of the weed in decreasing the quality of the crop or animal product. These are direct effects of weeds on crops. The toxic effect of a weed on man and animals was also a factor in describing weediness.

Identification of the world's worst weeds might be based also on the indirect effects of weeds as hosts of nematodes on crop production. Such a decision would be complicated and might be based on the number of nematode species hosted, weighted on their seriousness, the number of crops involved, and the area occupied by those crops, as well as the distribution of the weeds.

Based on the data discussed thus far about the major weeds of the nine crops included and the nematodes hosted by those weeds, Cyperus rotundus is by far the most serious weed. It hosts species in 19 genera of nematodes. It is an important weed in 74 countries and in seven of the nine crops. Following it in decreasing order are Cynodon dactylon, Digitaria sanguinalis, Chenopodium album, Eleusine indica, Sorghum halepense, Portulaca oleracea, Amaranthus spinosus, Echinochloa crus-galli, and Echinochloa colonum as the 10 most significant weed hosts of nematodes. Four of these weeds are monocotyledonous annual, three are monocotyledonous perennial, and three are dicotyledonous annual species. None of these 10 weeds is a dicotyledonous perennial species.

In the second group of 10, also listed in decreasing order, are: Convolvulus arvensis, Ageratum conyzoides, Cyperus esculentus, Stellaria media, Solanum nigrum, Rottboellia exaltata, Avena fatua, Spergula arvensis, Agropyron repens, and Cirsium arvense. Among this group there are two monocotyledonous annual, two monocotyledonous perennial, four dicotyledonous annual, and two dicotyledonous perennial species.

Of these 20 most significant weed hosts of nematodes, 11 are monocotyledonous species and 13 are annual species.

RESEARCH NEEDS

Although these types of data may seem to be subjective, they draw attention to the fact that weeds serving as hosts of nematodes affecting crops have an indirect effect on crop production and on crop production economy. There is an obvious need for more multi-disciplinary activity to clarify the impact of weed hosts of plant parasitic nematodes on race development of nematodes and on production of specific crops.

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Table 1. Genera of plant parasitic nematodes hosted by major commercial food and fiber crops of the world.

Crops	Genera of nematodes hosted[a]																			
	Mel	Pra	Hel	Tyl	Dit	Tri	Bel	Rot	Het	Par	Aph	Hop	Rad	Cri	Scu	Lon	Ang	Dol	Hir	Total
Oryza sativa L.	+	+	+	+	+	-	-	-	+	-	+	+	-	+	-	-	-	-	+	10
Triticum aestivum L.	+	+	+	+	+	+	-	-	+	+	-	-	-	+	-	-	+	-	-	10
Zea mays L.	+	+	+	+	+	+	+	+	-	+	-	+	+	-	-	+	-	+	-	13
Solanum tuberosum L.	+	+	+	+	+	+	+	+	-	+	+	-	-	-	-	+	-	-	-	11
Manihot utilissima Poul.	+	+	-	-	+	-	-	+	-	-	-	-	-	-	+	-	-	-	-	5
Glycine max (L.) Merr.	+	+	+	+	+	+	+	+	+	+	-	-	+	-	-	-	-	-	-	11
Arachis hypogeae L.	+	+	+	+	-	+	+	+	+	+	+	-	-	+	+	-	-	-	-	12
Saccharum officinarum L.	+	+	+	+	+	+	+	+	+	-	+	+	+	-	+	-	-	-	-	12
Gossypium hirsutum L.	+	+	+	+	-	+	+	+	-	-	-	+	+	-	-	-	-	-	-	9
Total	9	9	8	8	7	7	6	6	5	5	4	4	4	3	3	2	1	1	1	

[a]See Appendix 1 for names of nematodes genera.

Table 2. Genera of plant parasitic nematodes hosted by rice and the major weeds of rice culture.

Crop and major weeds[a]	WWW[c]	Genera of nematodes hosted[b]										
		Hel	Het	Pra	Aph	Cri	Dit	Hel	Hir	Hop	Tyl	Total
Oryza sativa		+	+	+	+	+	+	+	+	+	+	10
Cyperus rotundus	*	+	+	+	+	+	+	+	+	-	+	9
Eleusine indica	*	+	-	+	-	+	-	+	+	+	-	6
Echinochloa crus-galli	*	+	+	+	-	-	+	-	+	-	-	5
Echinochloa colonum	*	+	+	-	-	+	-	-	+	-	-	4
Cyperus iria		-	-	-	+	-	-	-	+	-	-	2
Cyperus difformis		-	-	-	-	-	-	-	+	-	-	1
Fimbristylis miliacea		-	-	-	-	-	-	-	+	-	-	1
Monochoria vaginalis		-	-	-	-	-	-	-	+	-	-	1
Total, for weeds	4	4	3	3	2	3	2	2	8	1	1	

[a]Authorship of crop binomials is in Table 1, of weed binomials is in Table 11.
[b]See Appendix 1 for names of nematode genera.
[c]World's worst weeds.

Table 3. Genera of plant parastic nematodes hosted by wheat and the major weeds of wheat culture.

Crop and major weeds[a]	WWW[c]	Genera of nematodes hosted[b]						
		Mel	Het	Pra	Dit	Hel	Tri	Total
Triticum aestivum		+	+	+	+	+	+	6
Chenopodium album	*	+	+	+	+	+	+	6
Stellaria media		+	+	+	+	-	-	4
Avena fatua	*	+	+	+	+	-	-	4
Polygonum convolvulus		+	+	+	+	-	-	4
Spergula arvensis		+	+	+	+	-	-	4
Convolvulus arvensis	*	+	-	+	+	-	-	3
Sinapsis arvensis		+	+	-	+	-	-	3
Raphanus raphanistrum		+	+	-	+	-	-	3
Cirsium arvense		+	-	+	+	-	-	3
Agropyron repens		+	+	-	+	-	-	3
Anagallis arvensis		+	-	-	+	-	-	2
Total, for weeds	3	11	8	7	11	1	1	

[a]Authorship of crop binomials is in Table 1, of weed binomials is in Table 11.
[b]See Appendix 1 for names of nematode genera.
[c]World's worst weeds.

Table 4. Genera of plant parasitic nematodes hosted by maize and the major weeds of maize culture.

Crop and major weeds[a]	WWW[c]	Genera of nematodes hosted[b]													
		Mel	Pra	Bel	Dit	Dol	Hel	Hop	Lon	Par	Rad	Rot	Tri	Tyl	Total
Zea mays		+	+	+	+	+	+	+	+	+	+	+	+	+	13
Cynodon dactylon	*	+	+	+	–	+	+	+	–	+	+	+	+	+	11
Digitaria sanguinalis	*	+	+	+	+	–	+	+	+	+	+	–	+	+	11
Cyperus rotundus	*	+	+	+	+	–	+	–	–	–	+	+	+	+	9
Chenopodium album	*	+	+	–	+	–	+	–	+	–	–	–	+	–	6
Sorghum halepense	*	+	+	–	–	–	+	+	–	–	–	–	+	+	6
Eleusine indica	*	+	+	–	–	–	+	+	–	–	–	+	–	–	5
Convolvulus arvensis	*	+	+	–	+	–	–	–	+	–	–	–	–	–	4
Amaranthus spinosus	*	+	+	–	–	–	–	+	–	–	–	+	–	–	4
Ageratum conyzoides		+	+	–	–	–	+	–	–	–	–	+	–	–	4
Cyperus esculentus	*	+	+	–	–	–	–	+	–	–	–	–	+	–	4
Portulaca oleracea	*	+	+	–	–	–	–	–	–	–	–	+	–	–	3
Echinochloa crus-galli	*	+	+	–	+	–	–	–	–	–	–	–	–	–	3
Cirsium arvense		+	+	–	+	–	–	–	–	–	–	–	–	–	3
Rottboellia exaltata	*	+	+	–	–	–	+	–	–	–	–	–	–	–	3
Digitaria adscendens		+	+	–	+	–	–	–	–	–	–	–	–	–	3
Galinsoga parviflora		+	–	–	+	–	–	–	–	–	–	–	–	–	2
Amaranthus hybridus	*	+	+	–	–	–	–	–	–	–	–	–	–	–	2
Agropyron repens		+	–	–	+	–	–	–	–	–	–	–	–	–	2
Setaria verticillate		+	+	–	–	–	–	–	–	–	–	–	–	–	2
Echinochloa colonum	*	+	–	–	–	–	–	–	–	–	–	–	–	–	1
Total, for weeds	14	20	17	3	9	1	8	6	3	2	3	6	6	4	

[a]Authorship of crop binomials is in Table 1, of weed binomials is in Table 11.
[b]See Appendix 1 for names of nematode genera.
[c]World's worst weeds.

Table 5. Genera of plant parasitic nematodes hosted by potato and the major weeds of potato culture.

Crop and major weeds[a]	WWW[c]	Genera of nematodes hosted[b]											
		Mel	Pra	Aph	Bel	Dit	Hel	Lon	Par	Rot	Tri	Tyl	Total
Solanum tuberosum		+	+	+	+	+	+	+	+	+	+	+	11
Digitaria sanguinalis	*	+	+	+	+	+	+	+	+	-	+	+	10
Chenopodium album	*	+	+	+	-	+	+	+	-	-	+	-	7
Stellaria media		+	+	+	-	+	-	+	-	-	-	-	5
Portulaca oleracea	*	+	+	-	-	-	-	-	-	+	-	-	3
Echinochloa crus-galli	*	+	+	-	-	+	-	-	-	-	-	-	3
Anagallis arvensis		+	+	-	-	+	-	-	-	-	-	-	3
Spergula arvensis		+	-	-	-	+	-	+	-	-	-	-	3
Polygonum persicaria		+	+	-	-	+	-	-	-	-	-	-	3
Cyperus esculentus	*	+	+	-	-	-	-	-	-	-	+	-	3
Bidens pilosa		+	-	-	-	-	-	-	+	-	-	-	2
Galinsoga parviflora		+	-	-	-	+	-	-	-	-	-	-	2
Agropyron repens		+	-	-	-	+	-	-	-	-	-	-	2
Total, for weeds	5	12	8	3	1	9	2	4	2	1	3	1	

[a]Authorship of crop binomials is in Table 1, of weed binomials is in Table 11.
[b]See Appendix 1 for names of nematode genera.
[c]World's worst weeds.

Table 6. Genera of plant parasitic nematodes hosted by cassava and the major weeds of cassava culture, ranked in decreasing order of totals.

Crop and major weeds[a]	WWW[c]	Nematodes hosted[b]				
		Mel	Pra	Dit	Rot	Total
Manihot utilissima		+	+	+	+	4
Cyperus rotundus	*	+	+	+	+	4
Eleusine indica	*	+	+	-	+	3
Amaranthus spinosus	*	+	+	-	+	3
Ageratum conyzoides		+	+	-	+	3
Digitaria adscendens		+	+	+	-	3
Euphorbia heterophylla		+	-	-	-	1
Total, for weeds	3	6	5	2	4	

[a]Authorship of crop binomials is in Table 1, of weed binomials is in Table 11.
[b]See Appendix 1 for names of nematode genera.
[b]World's worst weeds.

Table 7. Genera of plant parasitic nematodes hosted by soybean and the major weeds of soybean culture,

Crop and major weeds[a]	WWW[c]	Genera of nematodes hosted[b]											
		Mel	Het	Pra	Bel	Dit	Hel	Par	Rad	Rot	Tri	Tyl	Total
Glycine max		+	+	+	+	+	+	+	+	+	+	+	11
Cyperus rotundus	*	+	+	+	+	+	+	-	+	+	+	+	10
Digitaria sanguinalis	*	+	+	+	+	+	+	+	+	-	+	+	10
Chenopodium album	*	+	+	+	-	+	+	-	-	-	+	-	6
Sorghum halepense	*	+	+	+	-	-	+	-	-	-	+	+	6
Echinochloa crus-galli	*	+	+	+	-	+	-	-	-	-	-	-	4
Eleusine indica	*	+	-	+	-	-	+	-	-	+	-	-	4
Amaranthus spinosus	*	+	+	+	-	-	-	-	-	+	-	-	4
Ageratum conyzoides		+	-	+	-	-	+	-	-	+	-	-	4
Setaria glauca		+	-	+	-	-	-	+	-	-	+	-	4
Cyperus esculentus	*	+	+	+	-	-	-	-	-	-	+	-	4
Convolvulus arvensis	*	+	-	+	-	+	-	-	-	-	-	-	3
Amaranthus hybridus	*	+	+	+	-	-	-	-	-	-	-	-	3
Agropyron repens		+	+	-	-	+	-	-	-	-	-	-	3
Rottboellia exaltata	*	+	-	+	-	-	+	-	-	-	-	-	3
Digitaria adscendens		+	-	+	-	+	-	-	-	-	-	-	3
Echinochloa colonum	*	+	+	-	-	-	-	-	-	-	-	-	2
Datura stramonium		+	-	-	-	-	-	-	-	-	-	-	1
Physalis angulata		+	-	-	-	-	-	-	-	-	-	-	1
Commelina benghalensis		+	-	-	-	-	-	-	-	-	-	-	1
Mimosa pudica		+	-	-	-	-	-	-	-	-	-	-	1
Total, for weeds	12	20	10	14	2	7	7	2	2	4	6	3	

[a]Authorship of crop binomials is in Table 1, of weed binomials is in Table 11.
[b]See Appendix 1 for names of nematode genera.
[c]World's worst weeds.

Table 8. Genera of plant parasitic nematodes hosted by peanut and the major weeds of peanut culture.

Crop and major weeds[a]	WWW[c]	Genera of namatodes hosted[b]											
		Mel	Het	Pra	Aph	Bel	Cri	Hel	Par	Rot	Tri	Tyl	Total
Arachis hypogeae		+	+	+	+	+	+	+	+	+	+	+	11
Cyperus rotundus	*	+	+	+	+	+	+	+	-	+	+	+	10
Cynodon dactylon	*	+	+	+	-	+	+	+	+	+	+	+	10
Digitaria sanguinalis	*	+	+	+	+	+	-	+	+	-	+	+	9
Sorghum halepense	*	+	+	+	-	-	-	+	-	-	+	+	6
Eleusine indica	*	+	-	+	-	-	+	+	-	+	-	-	5
Ageratum conyzoides		+	-	+	+	-	-	+	-	+	-	-	5
Portulaca oleracea	*	+	+	+	-	-	-	-	-	+	-	-	4
Amaranthus spinosus	*	+	+	+	-	-	-	-	-	+	-	-	4
Dactyloctenium aegyptiacum		+	-	+	-	+	-	-	-	-	-	-	3
Rottboellia exaltata	*	+	-	+	-	-	-	+	-	-	-	-	3
Tribulus terrestris		+	-	+	-	-	-	-	-	-	-	-	2
Cenchrus echinatus		+	-	-	-	-	-	-	-	-	-	-	1
Setaria pallide-fusca		+	-	-	-	-	-	-	-	-	-	-	1
Total, for weeds	8	13	6	11	3	4	3	7	2	6	4	4	

[a]Authorship of crop binomials is in Table 1, of weed binomials is in Table 11.
[b]See Appendix 1 for names of nematode genera.
[c]World's worst weeds.

Table 9. Genera of plant parasitic namatodes hosted by sugarcane and the major weeds of sugarcane culture.

Crop and major weeds[a]	WWW[c]	Genera of nematodes hosted[b]											
		Hel	Het	Pra	Aph	Bel	Dit	Hel	Hop	Rad	Tri	Tyl	Total
Saccharum officinarum		+	+	+	+	+	+	+	+	+	+	+	11
Digitaria sanguinalis	*	+	+	+	+	+	+	+	+	+	+	+	11
Cyperus rotundus	*	+	+	+	+	+	+	+	-	+	+	+	10
Cynodon dactylon	*	+	+	+	-	+	-	+	+	+	+	+	9
Sorghum halepense	*	+	+	+	-	-	-	+	+	-	+	+	7
Cyperus esculentus	*	+	+	+	-	-	-	-	+	-	+	-	5
Eleusine indica	*	+	-	+	-	-	-	+	+	-	-	-	4
Amaranthus spinosus	*	+	+	+	-	-	-	-	+	-	-	-	4
Ageratum conyzoides		+	-	+	+	-	-	+	-	-	-	-	4
Portulaca oleracea	*	+	+	+	-	-	-	-	-	-	-	-	3
Panicum maximum		+	-	+	-	-	-	-	-	+	-	-	3
Rottboellia exaltata	*	+	-	+	-	-	-	+	-	-	-	-	3
Echinochloa colonum	*	+	+	-	-	-	-	-	-	-	-	-	2
Bidens pilosa		+	-	-	-	-	-	-	-	-	-	-	1
Total, for weeds	10	13	9	11	3	3	2	7	6	4	5	4	

[a]Authorship of crop binomials is in Table 1, of weed binomials is in Table 11.
[b]See Appendix 1 for names of nematode genera.
[c]World's worst weeds.

Table 10. Genera of plant parasitic nematodes hosted by cotton and the major weeds of cotton culture.

Crop and major weeds[a]	WWW[c]	Genera of nematodes hosted[b]									
		Mel	Pra	Bel	Hel	Hop	Rad	Rot	Tri	Tyl	Total
Gossypium hirsutum		+	+	+	+	+	+	+	+	+	9
Cynodon dactylon	*	+	+	+	+	+	+	+	+	+	9
Cyperus rotundus	*	+	+	+	+	-	+	+	+	+	8
Digitaria sanguinalis	*	+	+	+	+	+	+	-	+	+	8
Sorghum halepense	*	+	+	-	+	+	-	-	+	+	6
Eleusine indica	*	+	+	-	+	+	-	+	+	-	5
Solanum nigrum		+	+	-	-	-	+	+	-	-	4
Cyperus esculentus	*	+	+	-	-	+	-	-	+	-	4
Portulaca oleracea	*	+	+	-	-	-	-	+	-	-	3
Panicum maximum		+	+	-	-	-	+	-	-	-	3
Dactyloctenium aegyptiacum		+	+	+	-	-	-	-	-	-	3
Rottboellia exaltata	*	+	+	-	+	-	-	-	-	-	3
Echinochloa crus-galli	*	+	+	-	-	-	-	-	-	-	2
Convolvulus arvensis	*	+	+	-	-	-	-	-	-	-	2
Tribulus terrestris		+	+	-	-	-	-	-	-	-	2
Echinochloa colonum	*	+	-	-	-	-	-	-	-	-	1
Physalis angulata		+	-	-	-	-	-	-	-	-	1
Trianthema portulacastrum		+	-	-	-	-	-	-	-	-	1
Total, for weeds	11	17	14	4	6	5	5	5	5	4	

[a]Authorship of crop binomials is in Table 1, of weed binomials is in Table 11.
[b]See Appendix 1 for names of nematode genera.
[c]World's worst weeds.

Table 11. Important weeds associated with culture of major commerical food and fiber crops of the world.

Weed species	WWW[a]	Crops									
		Rice	Wheat	Maize	Potato	Cassava	Soybean	Peanut	S. cane	Cotton	Total
Cyperus rotundus L.	*	+	-	+	-	+	+	+	+	+	7
Eleusine indica (L.) Gaertn.	*	+	-	+	-	+	+	+	+	+	7
Digitaria sanguinalis (L.) Scop.	*	-	-	+	+	-	+	+	+	+	6
Ageratum conyzoides L.		-	-	+	-	+	+	+	+	-	5
Amaranthus spinosus L.	*	-	-	+	-	+	+	+	+	-	5
Cyperus esculentus L.	*	-	-	+	+	-	+	-	+	+	5
Echinochloa colonum (L.) Link	*	+	-	+	-	-	+	-	+	+	5
Echinochloa crus-galli (L.) Beauv.	*	+	-	+	+	-	+	-	-	+	5
Portulaca oleracea L.	*	-	-	+	+	-	-	+	+	+	5
Rottboellia exaltata L.f.	*	-	-	+	-	-	+	+	+	+	5
Sorghum halepense (L.) Pers.	*	-	-	+	-	-	+	+	+	+	5
Agropyron repens (L.) Beauv.		-	+	+	+	-	+	-	-	-	4
Chenopodium album L.	*	-	+	+	+	-	+	-	-	-	4
Convolvulus arvensis L.	*	-	+	+	-	-	+	-	-	+	4
Cynodon dactylon (L.) Pers.		-	-	+	-	-	-	+	+	+	4
Digitaria adscendens (H.B.K.) Henr.		-	-	+	-	+	+	-	-	-	3
Amaranthus hybridus L.	*	-	-	+	-	-	+	-	-	-	2
Anagallis arvensis L.		-	+	-	+	-	-	-	-	-	2
Bidens pilosa L.		-	-	-	+	-	-	-	+	-	2
Cirsium arvensis (L.) Scop.		-	+	+	-	-	-	-	-	-	2
Dactyloctenium aegyptiacum (L.) Willd.		-	-	-	-	-	-	+	-	+	2
Galinsoga parviflora Cav.		-	-	+	+	-	-	-	-	-	2
Panicum maximum Jacq.		-	-	-	-	-	-	-	+	+	2

Table 11. (Continued.)

Weed species	WWW[a]	Crops									
		Rice	Wheat	Maize	Potato	Cassava	Soybean	Peanut	S. cane	Cotton	Total
Physalis angulata L.		-	-	-	-	-	+	-	-	+	2
Spergula arvensis L.		-	+	-	+	-	-	-	-	-	2
Stellaria media (L.) Vill.		-	+	-	+	-	-	-	-	-	2
Tribulus terrestris L.		-	-	-	-	-	-	+	-	+	2
Avena fatua L.	*	-	+	-	-	-	-	-	-	-	1
Cenchrus echinatus L.		-	-	-	-	-	-	+	-	-	1
Commelina benghalensis L.		-	-	-	-	-	+	-	-	-	1
Cyperus difformis L.		+	-	-	-	-	-	-	-	-	1
Cyperus iria L.		+	-	-	-	-	-	-	-	-	1
Datura stramonium L.		-	-	-	-	-	+	-	-	-	1
Euphorbia heterophylla L.		-	-	-	-	+	-	-	-	-	1
Fimbristylis miliacea (L.) Vahl		+	-	-	-	-	-	-	-	-	1
Mimosa pudica L.		-	-	-	-	-	+	-	-	-	1
Monochoria vaginalis (Burm. f.) Kunth		+	-	-	-	-	-	-	-	-	1
Polygonum convolvulus L.		-	+	-	-	-	-	-	-	-	1
Polygonum persicaria L.		-	-	-	+	-	-	-	-	-	1
Raphanus raphanistrum L.		-	+	-	-	-	-	-	-	-	1
Setaria glauca (L.) Beauv.		-	-	-	-	-	+	-	-	-	1
Setaria pallide-fusca (Schumacher) Stapf & C. E. Hubb		-	-	-	-	-	-	+	-	-	1
Setaria verticillata (L.) Beauv.		-	-	+	-	-	-	-	-	-	1
Sinapsis arvensis L.		-	+	-	-	-	-	-	-	-	1
Solanum nigrum L.		-	-	-	-	-	-	-	-	+	1
Trianthema portulacastrum L.		-	-	-	-	-	-	-	-	+	1

[a]World's worst weeds.

Table 12. Number of countries reporting specific plant species as serious (S), principle (P), or common (C) weeds and the number of nematode genera (Nema) hosted by those weeds, with the weed species classified as monocotyledonous or dicotyledonous, annual or perennial, ranked in decreasing order of totals.

Weed species	WWW[a]	Importance				Nema hosted
		S	P	C	T	
		(No.)				
Monocotyledonous annual						
Digitaria sanguinalis (L.) Scop	*	23	8	39	13	
Eleusine indica (L.) Gaertn.	*	20	21	4	45	7
Avena fatua L.	*	8	14	9	31	7
Echinochloa crus-galli (L.) Beauv.	*	32	10	4	46	5
Echinochloa colonum (L.) Link	*	22	14	4	40	4
Setaria glauca (L.) Beauv.		8	4	10	22	4
Setaria virdis (L.) Beauv.		3	4	9	16	4
Setaria geniculata (Lam.) Beauv.		1	6	4	11	4
Rottboellia exaltata L.f.	*	8	6	1	15	3
Setaria verticillata (L.) Beauv.		6	5	7	18	2
Cyperus iria L.		3	10	1	14	2
Cyperus difformis L.		19	4	3	26	1
Lolium temulentum L.		3	2	18	23	1
Cenchrus echinatus L.		8	4	6	18	1
Monochorea vaginalis (Burm. f.) Kunth		6	4	1	11	1
Setaria pallide-fusca (Schumacher) Stapf & C. E. Hubb.		4	5	0	9	1
Monocotyledonous perennial						
Cyperus rotundus L.	*	52	18	4	74	19
Cynodon dactylon (L.) Pers.	*	28	29	6	63	15
Sorghum halepense (L.) Pers.	*	22	11	4	37	10
Cyperus esculentus L.	*	10	5	3	18	6
Paspalum dilatatum Poir.		2	4	3	9	5
Pennisetum clandestinum Hochst.		5	7	0	12	4
Panicum maximum Jacq.		10	9	3	21	3
Dactyloctenium aegyptiacum (L.) Wild.		7	7	6	20	3
Agropyron repens (L.) Beauv.		6	9	3	18	3
Digitaria adscendens (H.B.K.) Henr.		7	4	3	14	3
Paspalum conjugatum Bergius	*	12	9	1	22	2
Fimbristylis miliacea (L.) Vahl		11	5	1	17	1

[a]World's worst weeds.

Weed species	WWW[a]	Importance S	P	C	T	Nema hosted
		(No.)				
Dicotyledonous annual						
Chenopodium album L.	*	15	25	9	49	15
Amaranthus spinosus L.	*	8	14	9	31	8
Solanum nigrum L.		8	13	15	36	8
Portulaca oleracea L.	*	17	30	6	53	6
Capsella bursa-pastoris (L.) Medik.	*	4	13	19	36	6
Stellaria media (L.) Vill.		6	15	15	36	6
Sonchus oleraceus L.		2	8	20	30	6
Ageratum conyzoides L.		8	14	6	28	5
Polygonum convolvulus L.		9	11	7	27	5
Polygonum aviculare L.		8	17	11	36	4
Spergula arvensis L.		6	11	10	27	4
Sinapsis arvensis L.		8	15	9	32	3
Raphanus raphanistrum L.		9	14	8	31	3
Anagallis arvensis L.		2	11	16	29	3
Galinsoga parviflora Cav.		6	15	6	27	3
Tribulus terrestris L.		1	14	9	24	3
Amaranthus hybridus L.	*	6	8	5	19	3
Galium aparine L.		4	6	4	14	3
Bidens pilosa L.		8	16	9	33	2
Euphorbia hirta L.		4	14	8	26	2
Xanthium strumarium L.		0	3	8	11	2
Datura stramonium L.		13	5	16	34	1
Physalis angulata L.		3	5	12	20	1
Euphorbia heterophylla L.		4	6	7	17	1
Trianthema portulacastrum L.		5	3	6	14	1
Xanthium spinosum L.		1	2	5	8	1
Dicotyledonous perennial						
Convolvulus arvensis L.	*	14	19	6	39	5
Taraxacum officinale Wiggers		4	8	21	33	5
Rumex acetosella L.		6	14	12	32	5
Plantago major L.		0	2	20	22	5
Cirsium arvense (L.) Scop.		5	17	4	26	4
Polygonum persicaria L.		5	11	9	25	4
Rumex crispus L.		1	9	14	24	4
Plantago lanceolata L.		1	5	23	29	3
Lantana camara L.		10	12	3	25	2
Oxalis corniculata L.		2	5	19	26	1
Mimosa pudica L.		6	7	6	19	1
Commelina benghalensis L.		6	8	4	18	1
Sida acuta Burm. f.		7	3	4	14	1

[a]World's worst weeds.

Appendix 1. Names and abbreviations of nematode genera.

Ang.	Anguina
Aph.	Aphelenchoides (& Aphelenchus)
Bel.	Belonolaimus
Cri.	Criconemoides
Dit.	Ditylenchus
Dol.	Dolichodorus
Hel.	Helicotylenchus
Het.	Heterodera
Hir.	Hirschmanniella
Hop.	Hoplolaimus
Lon.	Longidorus
Mel.	Meloidogyne
Par.	Paratylenchus (& Paraphelenchus)
Pra.	Pratylenchus
Rad.	Radopholus
Rot.	Rotylenchulus
Scu.	Scutellonema
Tri.	Trichodorus
Tyl.	Tylenchorhynchus

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